Tension is reduced and infiltration improves

Wetting Agent Increases Water's Spreading Action

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(First of Two Articles)

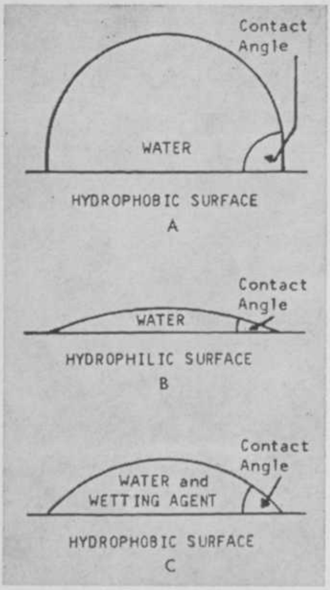

Figure 1 — Soils and soil mixtures present hydrophobic surface to water. Wetting agent reduces contact angle and moves water rapidly over treated surface.

WETTING AGENT	Percent Reduction in Evaporation					
	SAND			SOIL		
	FIRST WETTING	SECOND WETTING	THIRD WETTING	FIRST WETTING	SECOND WETTING	THIRD WETTING
AQUA-GRO	44.4	30.0	43.4	71.9	50.7	36.7
A	33.3	21.2	37.7	4.9	—	—
B	44.4	8.7	—	45.2	31.4	—
C	—	—	—	55.7	38.1	13.9
D	22.2	—	37.7	—	16.7	7.2
E	11.1	—	—	10.1	7.0	9.5
F	33.3	30.0	52.8	6.2	1.5	—
G	—	—	—	28.2	24.8	11.3
CHECK	—	—	—	—	—	—

Figure 2 — Texas A & M data show differences in commercially available wetting agents.

A wetting agent is a surfactant — a peculiar group of materials that are very active at surfaces. In this group are detergents, empulsifiers and, of course, wetting agents. Their difference is primarily in molecular weight and chemical structure. One very important difference in these materials is that they can be ionic or non-ionic. Original research showed that non-ionic materials were preferred because of their safety to living plant materials and micro-organisms. As an example, many ionic materials are used as scouring compounds and germicides, and can be very toxic to plants and soil organisms.

Non-ionic wetting agents usually consist of an alkyl and an aryl group of differing molecular weights, as an alcohol, an ester or an ether. These materials act in such a way that part of the molecule is water soluble and part is water insoluble. This strange behavior causes the attractive forces of water, which are exceptionally large, to be tremendously reduced. A few thousandth of one per cent will reduce these forces by more than 60 per cent.

To first explain their action in and on soil, let us look at a flat surface with a drop of water standing on it. The attractive forces of water tend to pull it up into a ball. We've all seen this on the leaves of grass. A wetting agent lowers these forces, and increases (if the insoluble portion is correctly chosen) the spreading

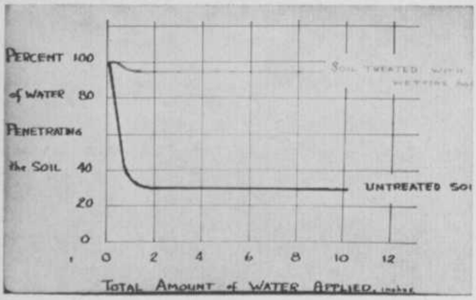

Figure 3 — Contrast in treated and untreated soils shows wide difference in penetration.

attraction of the water over the surface (figure 1).

Now let us look at a small pore in the soil — untreated soil that is! We see that the attractive forces of water will cause a bridging over of these pores and inhibit downward or sideward movement. It becomes necessary to increase the weight of water (filling of the large pores or saturating of the soil) before enough pressure is created to rupture this tension and force the water through the pore.

What happens in treated soil? With very little attractive force, bridging does not occur and the water readily wets the sides of the pore and moves downward and sideward without saturating. Data from Penn State shows that water passed through the entire profile at field capacity in one to two hours in a loam soil treated with a blended soil wetting agent.

In contrast, the untreated soil was

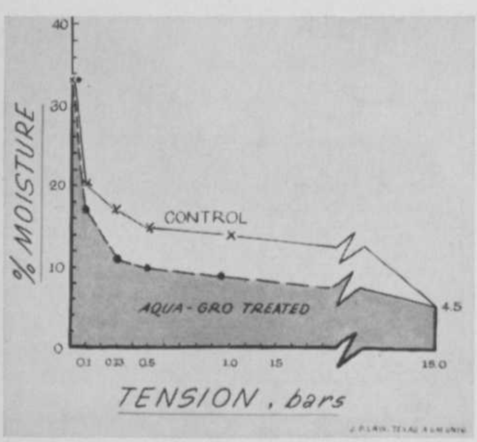

Figure 5 — Availability of moisture at any given soil tension is shown in this chart, developed by Texas A & M agronomy department.

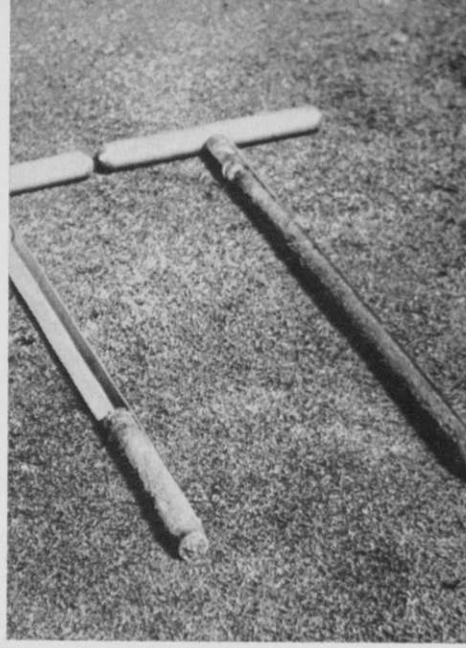

Figure 4 — Moisture is uniformly distributed to depth of 15 inches in treated soil. In untreated soil it penetrates only 1½ inches.

wetted to only one-third its depth and was above field capacity in this area. It takes between 24 to 48 hours for water to drain to field capacity in untreated soils. After 80 hours this unreated soil still had excess water, now located in its lower profile due to a perched water table effect.

The rapid drainage of saturating water through the soil profile to field capacity is extremely important. Soil, in good tilth, in a wet condition can be compacted with a feather simply by stroking the soil. When water takes 24 to 48 hours to drain to field capacity (as it does in most untreated soils), considerable compaction can occur from the typical situation of golfers playing two hours after a rain. The rapid drainage to field capacity of treated soils greatly reduces the changes of compaction.

So much for the action of soil wetting agents. Let's have a look at their effects. Figure 2 is recent work from Texas A & M and is shown to bear out that there are vast differences in commercially available wetting agents. As you can see, some materials were only effective for one irrigation, some only worked in one soil, some didn't work at all. What is desired is

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Wetting Agents

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a material that lasts for many irrigations and works in all soils and soil mixtures.

Figure 3 shows the improved infiltration and movement through treated soils. Water backing up in untreated soils due to tension bridging of the pores and slow movement reduces infiltration, and decreases the percentage penetrating with time.

The cores show this effect on treated and untreated halves of a green. The picture was taken the day after irrigation. Note the depth and uniformity of moisture in this core from the treated area (15 ins. versus about 1½ ins.) figure 4.

Infiltration alone is not the answer. Letey of U C L A has pointed out: "Soil treated with the wetting agent became wet much more uniformly throughout the entire core compared to the untreated soil in which moisture moved through in channels rather than in a uniform pattern".

Not Complete Answers

Once again infiltration and uniformity are not the complete answers. Soils treated with a blended non-ionic wetting agent hold water at a much lower tension. Figure 5 is from another paper from Texas A & M shows moisture content versus tension in the soil. The area under the curve represents the energy the plant must exert to obtain water (and, therefore, nutrients) from the soil. We feel that this conservation of energy is related to some of the cell structure improvements in the plant leaves. The immediate and definite benefit of this improved availability is an increase in the time between irrigations. Penn State and Cornell data (using tensiometers) showed a 100 per cent increase possible — we suggest only a 50 per cent increase. In a year's time, these lower tensions can save considerable water and labor (generally estimated at 30 per cent).

To summarize, we have seen improvement in infiltration, transport (drainage), uniformity, and availability of moisture in soils treated with a soil wetting agent. The increased infiltration and transport results in decreased puddling, run-off and compaction. The improved uniformity of profile wetting eliminates localized dry spots and promotes deep rooting. The increased availability of soil moisture and nutrients decreases the frequency of irrigation, improves the efficiency of water and nutrient use and saves an estimated 30 per cent in water and labor.

To Describe Meusel's Work

Next month we'll describe work done at Yale University by Harry Meusel. This work shows the effects that soil wetting agents, watering practices, and fertilizers have on the wilting, appearance, internal cell structure, and stomatal openings of poa annua.

This article is condensed from a speech made by Bob Moore at the recent Midwest Regional turf conference held at Purdue University.

Grau's Answers

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2. You may have more thatch and mat than you need. Disease organisms are protected from fungicides by the excess material. The double dose gave temporary relief by partly penetrating the dead material. Regular aerating and vertical mowing are needed to reduce excess grass, living and dead. Also you need active soil organisms to break down the mat as it accumulates.

3. Your soil may be acid which is encouraging to disease fungi. The lime raised the pH level temporarily and thus checked the growth of the organisms. No recommendations can be made until you have soil tests made. If you would send a copy to me I shall be glad to review it and offer suggestions. Your experiment station at V.P.I. will run the test and make recommendations.

P.S. Thank you for sending the additional information and profile slice so promptly that I could add these remarks:

Your Arlington bent has serious excess felt-mat accumulation which must be decomposed chemically and biologically. The grass is starved for nitrogen and is seriously overwatered. It is recommended that the greens be watered from 9 to midnight every second night instead of 9 p.m. to 6 a.m. every night. Add dolomitic limestone to the topdressing, one 80-lb. bag to 1 cu. yd. When you spray insoluble nitrogen on the greens add sulfate of potash, hydrated lime and ferrous sulfate (all as directed). Core the greens spring and fall and remove cores. While holes are open, rinse fertilizer deeply into holes. Microorganisms will benefit from less water, added lime, better aeration, and a supply of food and energy, enabling them to hasten decomposition of the mat.